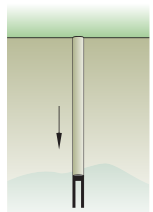
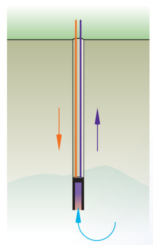
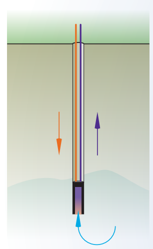
Flow Through In Situ Reactor



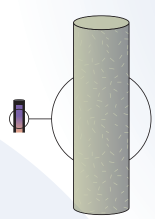
Insert bioreactor directly into waste site, creating partially encapsulated soil core



Continually inject treatment, which mixes with subsurface fluids entering bottom of instrument



Continually draw effluent out for analysis



Withdraw bioreactor and remove core sample for further analysis

In Situ Reactor Schematic

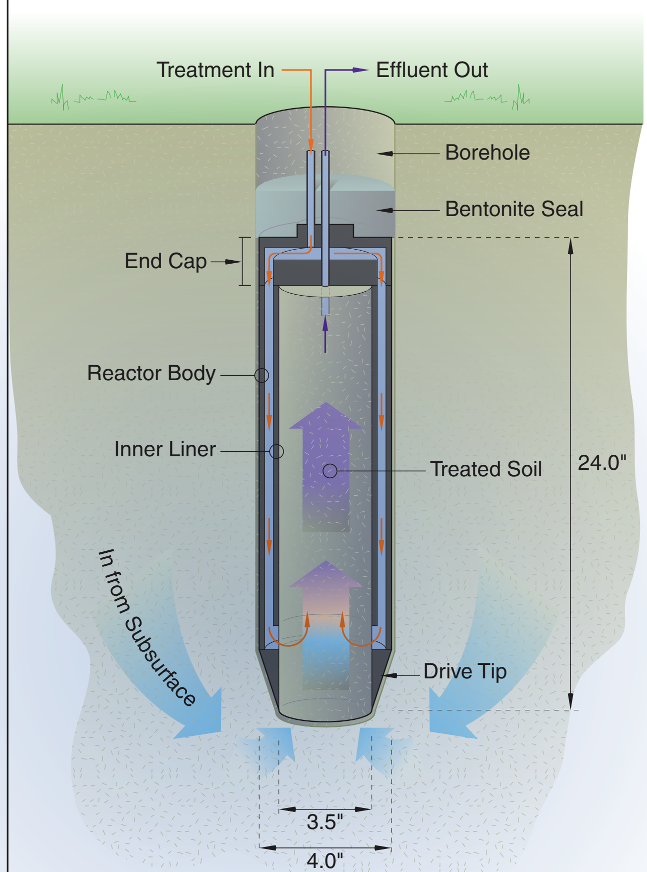


Figure 1. Schematic of installation and use of flow through in situ reactors (FTISRs) in the subsurface.

Pollution of subsurface waters and soils is a common problem across the United States and the world. However, a growing body of evidence suggests that laboratory studies, particularly those involving biological and chemical remediation, do not accurately mimic what occurs in the field. These laboratory studies usually involve removal of sediments and/or groundwater and subjecting these materials to treatments within the lab, followed by an assessment of the likelihood of these treatments to achieve cleanup objectives in the field. Obtaining samples for use in the lab often causes many types of stress to the biota in these samples, which results in shifts in the microbial community. Subsequently, data generated from these altered communities may not be predictive for the field site. A device that performs laboratory-scale experiments in the field is a way to overcome these laboratory shortcomings. INL has designed, fabricated and implemented flow through in situ reactors (FTISRs) to meet this need.

The invention is a direct-push installed, flow-through microcosm, which takes column

Continued next page

The Energy of Innovation

Idaho National Laboratory

Figure 2. Installing an FTISR using direct push rigging.

Continued from front

studies from the lab to the field (Figure 1). In doing so, many lab artifacts disappear, including errors from lab-to-field differences in temperature, microbial communities, dissolved gases, soil disturbances, and lab errors resulting from a lack of continual microbial recruitment from the surrounding formation.

Additionally, the reactors allow mass balance closure in contaminant precipitation studies, as the core may be removed after the investigation is complete. Also unique, the treated core containing the precipitated contaminant may be tested for remobilization by challenging with the appropriate acid or oxidative challenges, in situ.

In situ reactors can be used to optimize full-scale remediation efforts, currently an iterative and expensive task. Further, during installation (Figure 2), in situ reactors cause little disruption to the soil matrix and little or no introduction of exogenous contaminants, yielding exceptional results for examination of microbial flora and the chemical matrix after the core removal.

INL scientists have tested the reactors in the laboratory and field, receiving easy to interpret and usable resultant data. Both the field and laboratory installations have been successful and straightforward, without plugging or reactor damage, including running the reactors for multiple months in scenarios receiving organic carbon amendments.

For more information

Technical Contacts

Brad Blackwelder, M.S.
(208) 526-3250
D.Blackwelder@inl.gov

Mark Delwiche, M.S.
(208) 526-1870
Mark.Delwiche@inl.gov

Management Contact

Don Maiers
(208) 526-6991
Donald.Maiers@inl.gov

www.inl.gov/biologicalsystems

A U.S. Department of Energy National Laboratory

Patents/Publications/Presentations

Radtke, CW, Blackwelder, DB. 2004. US Patent #6,681,872 "In Situ Reactor"

Radtke, CW. 2005. In situ microcosm. Ph.D. Dissertation Chapter VI, available at http://etd.lib.ttu.edu/theses/available/etd-04082005-154502/unrestricted/CoreyRadtkeDissertationFINAL.pdf.

Blackwelder, DB, and Radtke, CW. 2005. Mesoscale Treatability Study Using Field Deployable, Flow-Through Microcosms. in: B.C. Alleman and M.E. Kelley (Conference Chairs), In In Situ and On-Site Bioremediation—*Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium*. Baltimore, Maryland. Battelle Press, Columbus, OH. Abstract A-14.

Blackwelder, DB, and Radtke, CW. 2005. Flow-through in situ reactors as a method for performing laboratory scale investigations within a treatment zone. In he *Joint International Symposium for Subsurface Microbiology,* Jackson Hole, WY. American Society for Microbiology.

08-GA50094-22-R4 R6-11